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## Catalysing Pathway Creation for Transition Governance

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Transition management is one of the key governance methodologies for catalysing vision building, experimentation and pathway construction for sustainability transitions. Its adoption in new country contexts may, however, require redesign. Finnish energy and climate policy already features wide experimentation, visioning and long-term roadmaps. Yet transition arenas could help connect these existing instruments, particularly if redesigned for a mid-range timescale. We improved the path creation toolsets and procedures to create more detailed pathways and analyses of pathway step interrelations. Our path creation system uses magnetic elements that could be easily moved around a large metallic board, a set of procedures and a digitalized counterpart of the board for out-of-the-workshop commentary and reporting. The system was used to create eight mid-range transition pathways and was reported to have facilitated and anchored well the discussions by participants with cross-sectoral backgrounds. Overall, the redesigned system underscores the potential that codesign for sustainability transitions holds, for instance, in developing transition governance instruments further.

*transitions; design research; collaborative envisioning; energy*

### 1 Introduction

The need for thoroughgoing system transitions has become urgent in several areas such as energy, transport and water use. Climate change and advancing resource scarcity exert growing landscape pressure on the dominant sociotechnical regimes in these sectors. At the same time, alternative technologies and social arrangements are maturing in many sectors and offering alternatives that can begin to reconfigure or replace the dominant sociotechnical regimes (Geels, 2004; Geels & Schot, 2007).

In the energy system, improved energy efficiency and the replacement of fossil fuels with increasingly cheaper renewable energy are changing the ways in which energy is produced, distributed and used in all sectors. For example, an increasing share of intermittent electricity production creates the need for new market models, products and services: demand response, storage and flexible production. The need to anticipate and investigate the forms and timing of the



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needed changes as well as their impacts on different sectors thus becomes evident. Transition requires change in the current dominant regime as well as new technologies, business models, competencies and institutions. Many of these changes benefit from (or require) anticipatory action, societal experimentation and policy changes and thus require localized forms of governance (Heiskanen, Kivisaari, Lovio, & Mickwitz, 2009; Sovacool, 2016).

The steering and governance of systemic transitions has been investigated since the late 1990s in several multidisciplinary lines of research. The nurturing, empowering, shielding and expanding of alternative niche innovations has been researched in strategic niche management and the social embedment of technology (Hoogma, Kemp, Schot, & Truffer, 2002; Rene Kemp, Schot, & Hoogma, 1998; Kivisaari, Lovio, & Väyrynen, 2004; Smith & Raven, 2012). Policies, policy mixes and rationales for interventions that disrupt dominant sociotechnical regimes and make room for change have been investigated (Kivimaa & Kern, 2016; Weber & Rohracher, 2012). Among the longest lines of transition steering is transition management (TM), which originated in the Netherlands in the 2000s and has developed through a Dutch energy transition initiative (René Kemp, Loorbach, & Rotmans, 2007; Loorbach & Rotmans, 2010) and a range of regional and city-specific transition projects (Frantzeskaki, Wittmayer, & Loorbach, 2014; Roorda, Frantzeskaki, Loorbach, Van Steenberghe, & Wittmayer, 2012).

In recent years design for sustainability transitions has entered onto the transition research and governance scene. Design research has engaged the field in various ways, for instance, it has generated experiential future scenarios and change pathways (Gaziulusoy & Ryan, 2017a, 2017b), and has pursued long-term local experimentation engagements aimed towards low carbon transition have drawing from community design and practice theory (Jalas et al., 2017; Manzini & Rizzo, 2011). It has further built anticipatory strategic design initiatives in order to target the critical aspects of evolving transitions (Mok & Hyysalo, 2017). Design agendas have also been proposed that resonate with sustainability transitions research, such as transition design (Irwin, 2015; Irwin, Kossoff, Tonkinwise, & Scupelli, 2015) and design for environmentally sustainable social innovation (Jégou & Manzini, 2008; Manzini, 2014). Through all these engagements the potential of design research has been begun to be noted by other disciplines, for instance, it is visible in codesign being seen as one of the contributing fields to TM (Ferguson, Brown, Frantzeskaki, de Haan, & Deletic, 2013).

Our work is positioned in the above developments to advance the governance of transitions in a specific country context (Finland) in the mid-range (to 2030). It stems from the design work package of the larger Smart Energy Transition (SET) consortium and is focused on multidisciplinary governance experiments between the public sector, private companies and citizens. Our particular interest has been to redesign transition management tools to suit the Finnish context. The political cultures and dynamics of non-state actors differ from one country to another and 'transferring' the TM methodology to new country contexts involves necessary translation – which can be seen as a source of innovation in itself. The translations may vary heavily, ranging from different hybridizations to more profound implementations that question and rework the methodology pervasively (Heiskanen et al. 2009 p.213-415), and in doing so they can make useful contributions to theoretical development as well (ibid. p. 425).

Regarding the Finnish context, there are over one hundred experiments related to energy transition and relatively established parliamentary long-term climate roadmap (running to the year 2050) as well as mid-range climate roadmap and governmental energy and climate strategy for mid-range planning (running to the year 2030). However, what is currently missing is the means to connect the visions and goals with experiments on the ground in the mid-range, in other words, the means to deliberate over the change pathways, which is one of the core aims of *transition arenas* within the TM methodology.

Transition arenas are deliberative settings where groups of societal stakeholders can envision and build pathways of change to transition goals. On beginning to implement transition arenas in the Finnish context, it became evident that the available path creation toolsets were geared towards a long-term focus of 40–80 years (Frantzeskaki, Broto, Coenen, & Loorbach, 2017; Roorda et al., 2012) and, consequently, they were too broadscale and unspecific to guide mid-range concretization. Given our mid-range focus that only extends to 2030, our pathway creation tools needed to become considerably more specific as well as supportive of multi-actor deliberation in fast-paced workshops.

In the next sections we contextualise the pathway creation tools and their design challenges, along with our research through design methodology. We then introduce the final pathway creation system, the outcomes of its use in the transition implementation arena in Helsinki in 2017, and the participant and facilitator evaluations of the system. Conclusions and further research avenues follow.

## **2 The rationale and design challenges for pathway creation tools and methods**

The focus of TM is on long-term policy design with relevant groups of “frontrunner” stakeholders. TM practices happen through creating spaces for searching, learning and experimenting on the transformation of the current system. It aims, on the one hand, to capacitate frontrunners with visions, concepts and seeds for thought that can be utilised in political decision making beyond the political cycle of elections. On the other hand, TM focuses on identifying settings for sociotechnical experiments and learning from them so that the experiments can be strengthened and scaled up, and eventually displace the problematic aspects of previously dominant regime (René Kemp et al., 2007; Loorbach & Rotmans, 2010).

TM further emphasizes the process of constructing pathways for meeting the long-term vision and specific transition goals. A further aim lies in creating a perspective on intersectional dynamics that can encourage transitional change: “The general approach is one of nurturing and growing rather than planning and controlling long-term societal change.” (Voß, Smith, & Grin, 2009 p. 277). In order to plan for long-term change, the focus is not only on the positive expectations for change, but also on negative ones that may prevent or hinder the change goals from unfolding (ibid p. 280). The schematic overview of TM is as follows (Loorbach & Rotmans, 2010; Voß et al., 2009):

1. Establishing a transition arena (or arenas)
2. Developing a common vision
3. Pathway development through backcasting techniques
4. Experimenting with pathway options
5. Monitoring, evaluation and revisions to pathways and experiments

TM as an approach for long-term policy design has faced some challenges over the years it has been practised. Voß et al. (2009) provide an overview of the policy design challenges TM faces. The common denominator that Voß et al. (2009) identified in TM challenges is that “TM as a concept for policy lacks effective provisions for inclusive participation and fair deliberation within ‘transition arenas’”. They further argue that the original TM principles have veered, in practice, towards the domination of powerful incumbent actors in arenas, a somewhat instrumentalist focus, and limited width and depth of civil deliberation. Voß et al. (2009) seek to remedy these aspects through increased civil society participation and ensuring a broader sustainability focus.

Our response seeks to address some of the critique of Voß et al. through seeking to anchor the transition arena vision and goal setting phases in the parliamentary long-term climate roadmap for 2050, a mid-range climate plan for 2030, and energy and climate strategy for 2030 in order to foster higher legitimacy for the process in conjunction to existing democratic processes. We further explicitly link the pathways of change to the many experiments that are already running so as to give

voice and visibility to civil society, the public sector and business actors who are already active in transitions. The frontrunners who participated in the arena were carefully selected from among 90 Finnish change makers, known through an SET-consortium's wide networks in energy and climate governance. The final selection was based on participants' competences and complementarity regarding the Finnish energy system. The selected 23 persons formed a group that covered well the frontiers of Finnish political, civil servant, business, and civil society actors regarding energy transition and together they provide a wide variety of angles with which to examine the topic.

The transition arena process in Helsinki was carried out over six three-hour workshops held at one-month intervals, during which participants could comment on refined results from the previous workshop in the closed website of the arena. The schedule was as follows:

- Workshop 1. The drivers, challenges and contingencies for transition
- Workshop 2. Vision and transition goals for 2030
- Workshop 3. Formation of pathways, part 1
- Workshop 4. Formation of pathways, part 2
- Workshop 5. Immediate actions for launching the pathways
- Workshop 6. Completing the results and commenting on the final report

The design challenge regarding mid-range path creation tools and procedures for workshops 3, 4 and 5 comprised of six interlinked aims and seven further specifications:

1. To allow a small group of 3–7 co-located participants from different walks of life to deliberate and effectively form a path to a mid-range transition goal from the current state
2. To provide participants with clear means to analyse the interrelationships between pathway steps and the timing of needed actions
3. To help participants to evaluate the realism of the suggested steps and the range of actions (regulatory, investment, business, technology development, civil society, research, behavioural change etc. actions) through which the pathway steps can become realised or their realisation supported
4. To help participants to recognise pathway and step interlinkages and the most critical steps in which societal choices have to be made
5. To help participants to highlight alternative transition paths with respect to the most important change drivers and uncertainties
6. To consider the effects of the most important uncertainty and contingency factors in the pathways and the steps therein

The chosen arena implementation method set the following specifications for the final design of the pathway creation tool:

- a. The working time with one pathway is limited to one or two half-day workshops
- b. The participants should be busy, and they should quickly understand how to use the tool
- c. The tool should be flexible so that it can be modified during the pathway creation process if needed; the openness of the arena process may lead to goals and directions that were not planned beforehand
- d. The elements of the path creation should be easily recognizable so that the participants do not confuse them with each other, even in the hectic pace of the arena workshops
- e. The materials should be easily movable over the game board
- f. The materials should enable feeding the needed information into the process as well as incorporating the information created during the process without truncating it
- g. The contents should be easily digitized
- h. Game boards should allow at least four persons to work on an individual pathway at a time

### **3 Research through design in creating the path creation tool**

In designing the pathway creation tools we drew from designing tools for codesign (Ehn & Kyng, 1991; Muller, Wildman, & White, 1993), participatory design games and their development (Eriksen, Brandt, Mattelmäki, & Vaajakallio, 2014; Vaajakallio, 2012) and game design (Zimmerman, 2003). Our design decisions were based on several testing and codesigning sessions within the design team, within a broader set of colleagues who were not involved in the design and with a yet broader set of transition arena team members. The very final iterations were made between the two workshop sessions of the transition arena process. Each time the pathway tool prototype and instructions were enacted akin to playtesting (Zimmerman, 2003), and the designers observed the situation, made notes, and asked questions and design ideas from the participants. After the testing sessions they adjusted the design to get to the next prototype version. The design team had a further division of responsibilities in testing and iterative design. Author 1 held responsibility over the overall concept development and balancing of different priorities in each iteration. Author 2 was responsible for the detailed design and productization of the pathway creation tool and, with Author 3, Author 2 explored the material choices and ideated design alternatives to be tested in iterations. Author 4 acted as substance expert on energy systems and relayed information about issues and participants to the rest of the team. The design team was further helped by a public deliberation expert who participated in all testing sessions and kept a continuous eye on the quality of the deliberation that the tool and its procedures may foster, as well as the on the validity of the design with respect to more traditional backcasting methods in futures research. These different competencies and perspectives fostered productive dialogue about the solutions and issues to be considered in the process.

### **4 The outline, elements and procedures of the path creation tool**

#### **4.1 *Outline and key elements***

The pathway creation tool is premised on a set of predefined forms and categories. These are used in constructing change pathways and were designed to give sufficient visibility to both content and form for all the participants during the process and also to both ease the movement of the elements and transforming the pathway in the course of the pathway construction.

The pathway creation work takes place on a 240 cm x 150 cm metallic board, onto which only a white print with light hexagonal grid has been permanently printed to give structure. All other elements are magnetic to allow flexibility in moving timelines and elements around as pathway construction progresses. The magnetic elements – pathway steps, arrows and pathway step realization actions – all have a writing surface on which participants can add content with markers. The magnetic elements allow the easy manipulation of pathway interrelations and the markers allow the easy modification of content as text can be wiped out with wet cloth. The size and height of the vertical board is designed to allow 3–5 people to work effectively on elements, both independently and in a group, and to allow them to reach to the top of the board (at 230 cm) and the bottom (at 79cm, see Figure 1).

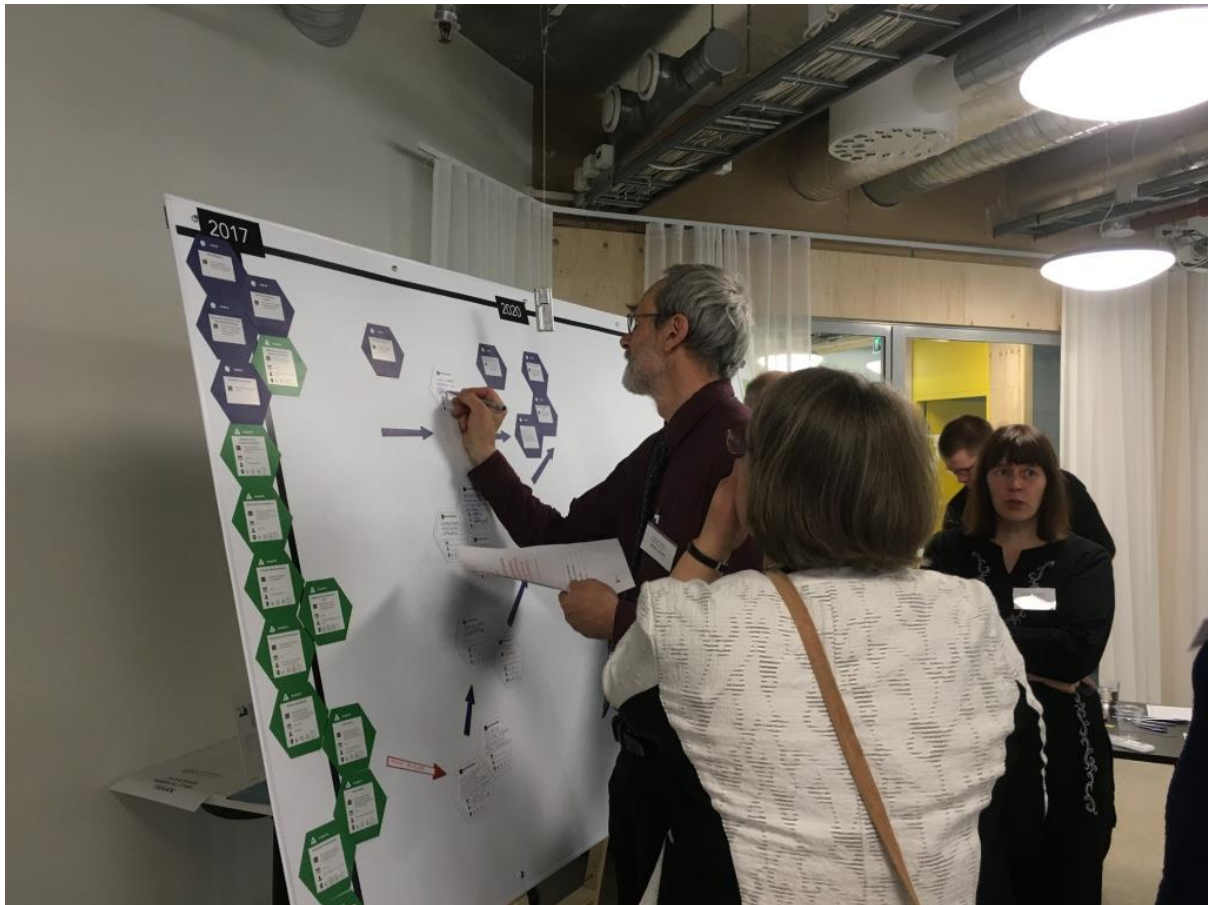


Figure 1. Pathway creation in its early stages.

The primary elements of the pathway creation system are the “pathway step” and “pathway-step action” elements. Both have the same structure: upmost, the designator of the form (e.g. *pathway step* or *investment*), then four rows for describing the step content, followed by timing (in years), the key actor(s), and the scale(s) which this element concerns: a national issue, a regional issue, on the suburb/village scale or concerning individual buildings and consumers (Figure 2). To differentiate the elements a combination of distinctive symbol, text and colouring is used for each.



Figure 2. A pathway-step element and an example of a filled-in pathway step.

The pathway-step action elements concretize how each pathway step can be realised or facilitated. The ones created thus far are specific to energy transition: energy production, business, end consumption, regulation, investment, other, technology, pilot (Figure 3, left-hand side). We also

designed a set of organizer elements to guide the work. “Fact elements” are used to render visible key milestones and facts about the pathway (see more below) and the question mark, exclamation mark and quotation mark are used to point out missing or insufficient pathway steps regarding change targets, critically important areas and needs for new research respectively, with the aim of focusing participant attention on these areas (Figure 3, right-hand side). The choice of hexagon-shaped elements, descriptive labels and colour coding was based on their common use in countless board games and ideation systems (Hodgson, 1992).

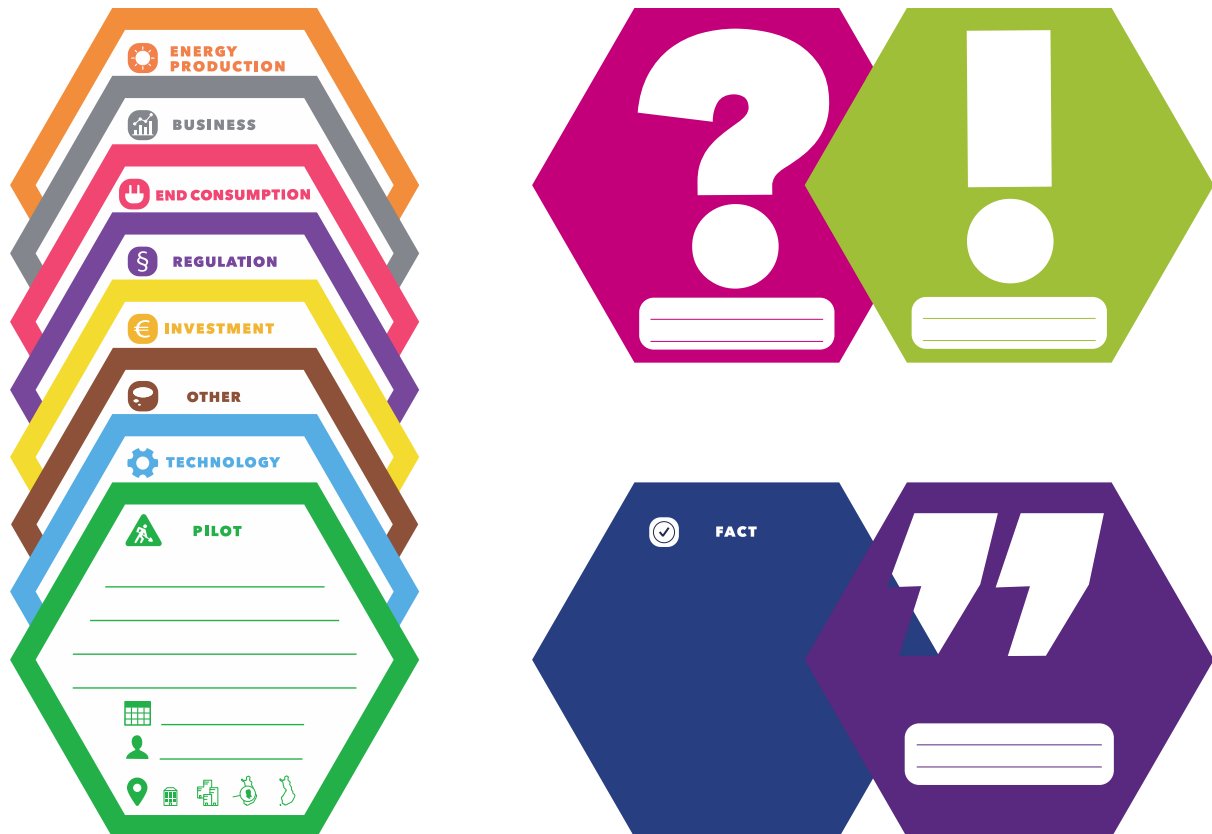


Figure 3. On the left are pathway-step action elements: energy production, business, end consumption, regulation, investment, other, technology, pilot. On the right are organizer elements: a fact, an attention marker, a missing action marker and a research marker.

The interrelations between elements can be clarified with magnetic arrows (which allow writing onto them) to show how one pathway step leads to another. Once the pathway is completed on the board it is rendered digitally, which allows further commentary, cleaning and the opening of all content to full sentences that are understandable to those beyond the participants in the path creation (see Figure 4 for a completed pathway).

Prior to the pathway construction, participants are given a 4–6 page information package related to the current state, the envisioned pathway goal and known challenges. The information in the package is also partially rendered visible on the board in a data-derived “persona” (Cooper, 2004) sheet of a family living in 2030, implicated by the pathway (Figure 5), as well as through placing key facts and pilots tentatively on the board as prefilled fact and pilot elements (see the block green and blue elements in Figures 3 and 4).



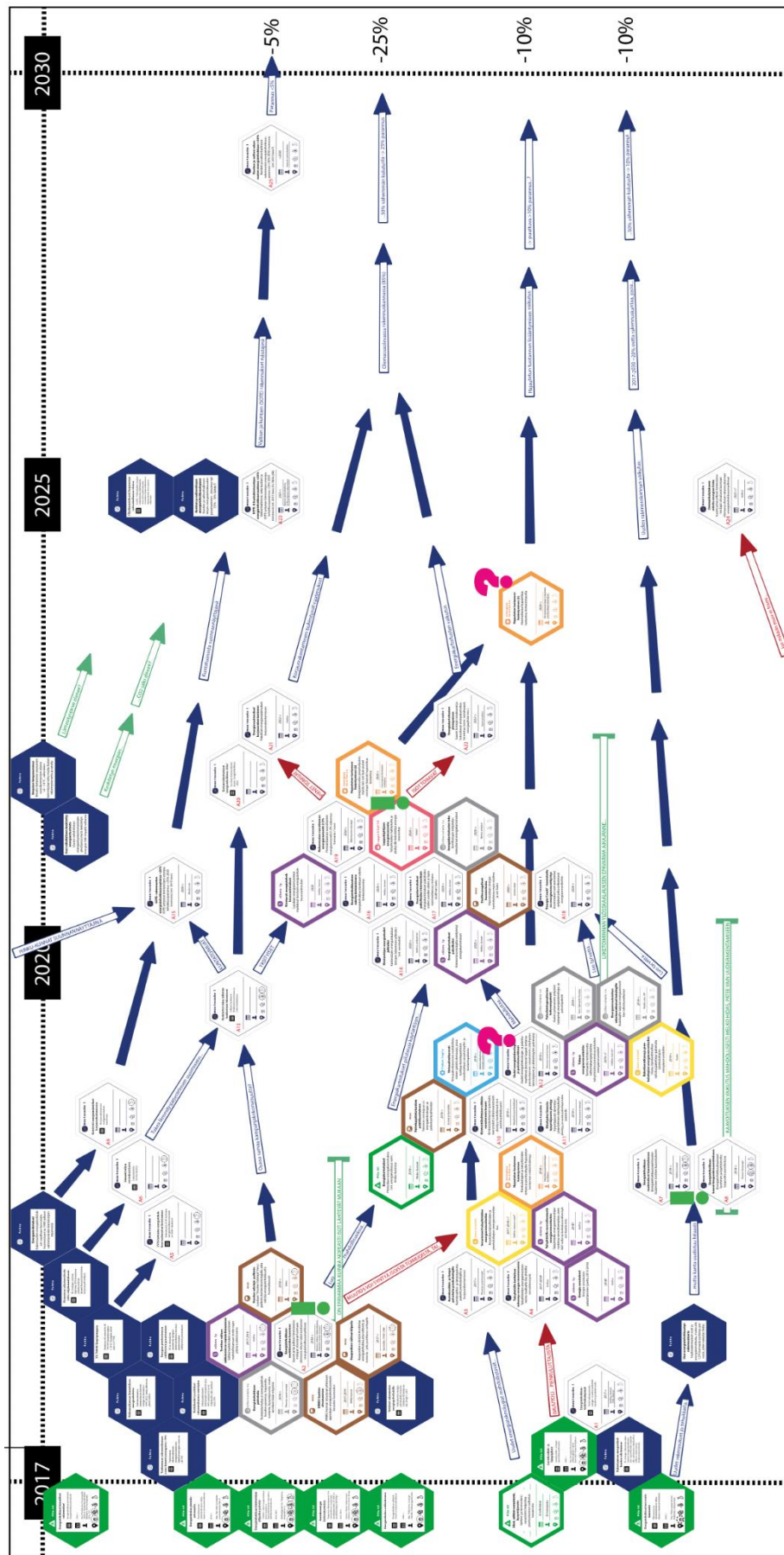


Figure 4. The final digitized path for halving a building's net-energy use by 2030.

## VISION PERSONA

Smart Energy Transition



### FAMILY KUKKONEN & JOKINEN

**SOFIA KUKKONEN: 48 years**

Teacher, 3600€/month

**ARI JOKINEN: 46 years**

Teacher, 3500€/month

**LINDA KUKKONEN: 8 years**

Grade schooler

### LIVING

Centre of Oulu, Torikatu, 82m<sup>2</sup> apartment building, built 1972.

Sofia is in the board of housing cooperative together with Erkki 74 years, Markku 78 years and Lasse 55 years.

### ENERGY CONSUMPTION AND USAGE

Heating: District heating, indoor air temperature 22-24C

Electricity: 2400kW per year

### FREE TIME

Each family member has their hobbies in the centre of Oulu.

### TRANSPORTATION

Own car and public transport in the centre of Oulu

### INTEREST

- Improve the real estate energy efficiency cost-effectively.
- Save in expenses, support climate friendly energy.

## ASSUMPTIONS RELATING TO PATHWAY IN 2030

"Reducing household energy consumption by change in behavior by 15%"

A) Pipe and roof repairs planned for the house, window repair in 10 years' timeframe. Sofia has suggested the housing cooperative that everything should be done simultaneously. She has also proposed for 20m<sup>2</sup> solar panels, 30m<sup>2</sup> solar heat collectors, extra insulation, forced ventilation and connecting the house in remote controlled demand response system for heating. The rest of the board is doubtful about how can the residents finance big repairs. The middle age of residents of the house is 63 years.

B) Sofia has ordered a preliminary review from ESCO company, but the role of its actions in the middle of other repair projects is unclear.

Picture 5. One of the final personas implicated in the envisioned mid-range 2030 goal.

#### **4.2 *The procedure of pathway construction***

From the starting position, the participants begin by discussing the target and pathway on a general level. The facilitator urges them to write down their thoughts about pathway step elements whenever an obvious step is identified. As steps cumulated, discussions begin to include their interrelations and potentially missing steps. In all the paths created thus far, the elements were rearranged several times and sub-pathways emerge, either from the onset or through the branching of the paths. At some point, the deliberation tends to veer towards considerations of whether each step is needed, whether some steps are realistically attainable and whether all the steps in all the sub-pathways together amount to sufficient change regarding the transition goal.

Once the main pathway steps have found a more or less steady and mutually agreed on form, the participants move to identifying the most important and most crucial steps and marking them with yellow stickers, and correspondingly marking where blocking points may reside in the pathway with black stickers.

This constitutes the first phase in the pathway construction. At this point the first documentation round happens through participants being asked to explain to the video camera the pathway and its key features and new insights they gained during the path construction.

The second phase of the pathway creation process is a more detailed examination of all steps, or at least the most important steps. The actions needed to realize each pathway step (technology development, regulation, changes in consumer behaviour, pilots, investments et cetera; see Figure 2) are discussed and marked down. At this point it is common that some pathway steps become merged and some new steps are added in. Also, some pathway steps may now be considered to actually be the actions for realizing another step (Figure 6). At the end of the second phase, the participants video the detailed concretizations to ensure that the ideas written down on cards are sufficiently elaborated.

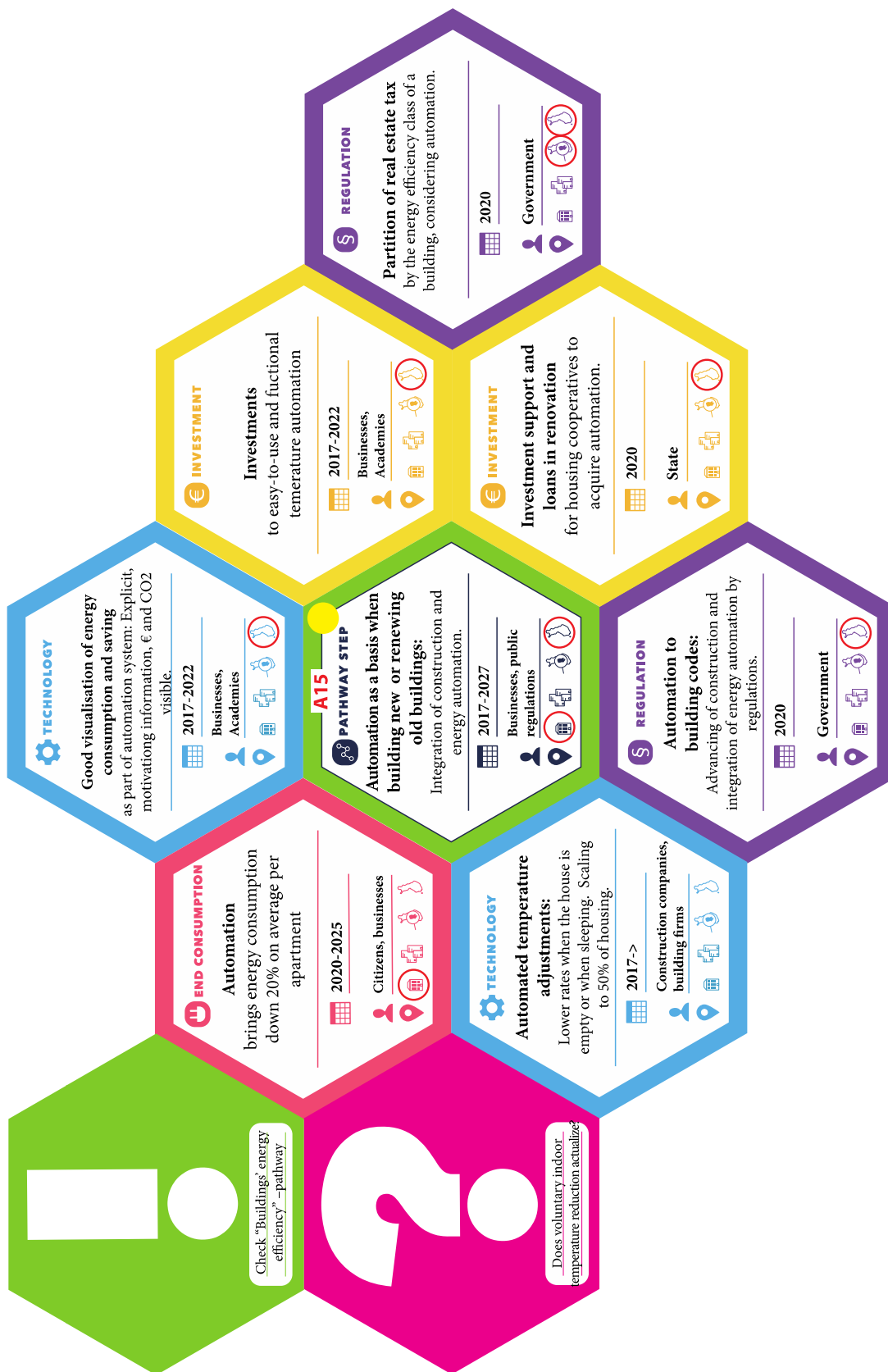


Figure 6. An example of a pathway step for which the facilitating actions have been explored in detail (translated by the authors).

The third phase of the process moves into uncertainties and contingencies. At this point the facilitator changes from blue marker pens and blue arrows to green ones and adds in probability markers of varying lengths (Figure 7). The participants then go through each step and examine the likelihood of the steps; can they occur sooner or later and how uncertain are they? The overall uncertainty factors are already identified in the second workshop of the series and can now be used to gauge the uncertainties related to specific pathways. The participants then add potential contingency responses, which are marked with green arrows, and green-stickered and green-written pathway steps. The outcome is again videorecorded. The very final phase is that of considering the alternative, mutually exclusive change pathways to the original pathway. These are identified with red-stickered steps, red texts and red arrows. This step is done last because alternative paths typically require rearranging the original paths and thus the originals must have been first documented without interference from mutually exclusive paths or steps.

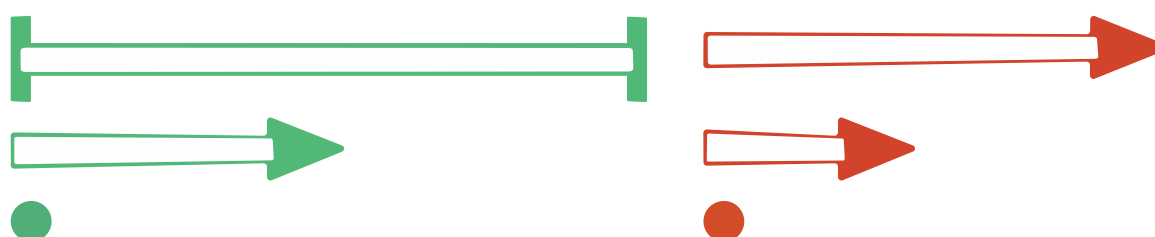


Figure 7. Uncertainty arrows, probability markers and stickers (left) and alternative arrows and stickers (right).

Once the entire pathway is complete it is digitized and uploaded on the password-protected support website of the transition implementation arena. If pathway construction is spread to multiple workshops, incomplete pathways can also be digitized and shared in the platform to allow between-sessions commentary.

Pathway creation relies heavily on following the procedures, facilitator assistance and her or his actions to keep both the participant discussion and path construction actions on track. To aid this, both detailed participant instructions and facilitator instructions were created, along with a guide for how to transfer the physical board's state into a digitized environment in a unified way. We found it useful to use two separate people for each board – one working as facilitator and the other as a note taker – who both participated in digitizing the contents. The digitalization was done using InDesign's and Illustrator's ready-made templates that could, in turn, be directly used in the final reporting format of the arena process.

## 5 The outcomes and participant evaluation of the path creation process and tool

### 5.1 Process outcomes

The transition implementation arena succeeded in creating a range of outcomes: articulating a more ambitious and inspiring energy and climate vision for Finland in 2030; creating an understanding of the change drivers, impediments and uncertainties in achieving an ambitious energy vision; identifying thirty intermediate goals for 2030; and, most importantly for us here, creating eight detailed pathways of change for the most important transition goals and identifying over one hundred immediate actions to be taken along these pathways. The amount of information which the transition implementation area creates is considerable. Even when heavily condensed, the Helsinki process amounted to a 200-page report (HYYSALO et al., 2017).

The 2030 pathways that were created were as follows: coal is phased out by 2030; creating 2000 MW in demand–response capacity in electricity; creating 2000 MW in demand–response capacity in

heating; halving building net-energy use; reducing household energy use by 15% with behaviour-change measures; having 750 000 alternative energy vehicles on Finnish roads by 2030; reducing total mileage by 10% through mobility as a service; and doubling the clean energy technology exports of Finland. Some of these transition goals were such that there was a fair amount of background studies that could be used to ground the work and the participants had already made exercises related to some of them, such as the promotion of electric cars. Some others, such as the ambitious 15% energy consumption reduction through behaviour change and the doubling of cleantech exports, featured greenfield aspects. These paths thus included new ideation over what pathway steps might be sufficient and feasible (even in principle) in order to reach the transition goal. This took more time than anticipated and in such paths the resilience analysis based on contingency factors had to be reduced.

The final report was released in November 2017. It was handed over to a Minister of the Finnish Government and its key messages were discussed in a panel by four members of Finnish Parliament and the head of the board of the largest Finnish public financing agency in an event in which one hundred invitees from ministries related to energy transition, businesses, civil society and academic organisations participated. The report was featured on headline TV news, morning TV and in 16 newspaper articles, which basically covers all the relevant major Finnish media. It further received 250 posts in a “new energy policy” social media discussion group and 30 related blogs and several columns appeared.

Decision to launch three new transition arenas has already been made. The participants in the 2017 Helsinki arena also wanted to hold a monitoring meeting in May 2018 to see if any further coordinated actions were needed and could be ideated among them. There has also been considerable interest from other actors and several discussion invitations from both regime and niche actors have followed. Whilst this is promising, it is too early to speak of the research’s societal impact apart from it evidently having gained some attention and interest.

## **5.2 Path creation tool evaluations**

The path creation tool was evaluated by both by the arena participants and the facilitators after the arena process. Twelve statements and an open commentary field were used. The most positive aspects received an average of 4 or above on a 1–5 scale from both participants and organizers; and these were for statements 1, 4, 6, 8, 9 (see Figure 8), which all deal with the overall experience and quality of deliberation in using the pathway creation system. The statements least agreed with were 12, 11, 10 and 5 (see Figure 8 and the discussion below). Statement 7 featured high variation in participant responses and we suspect this to have resulted from ambiguity in the Finnish wording as open-ended questions received mostly affirmative responses on this topic.

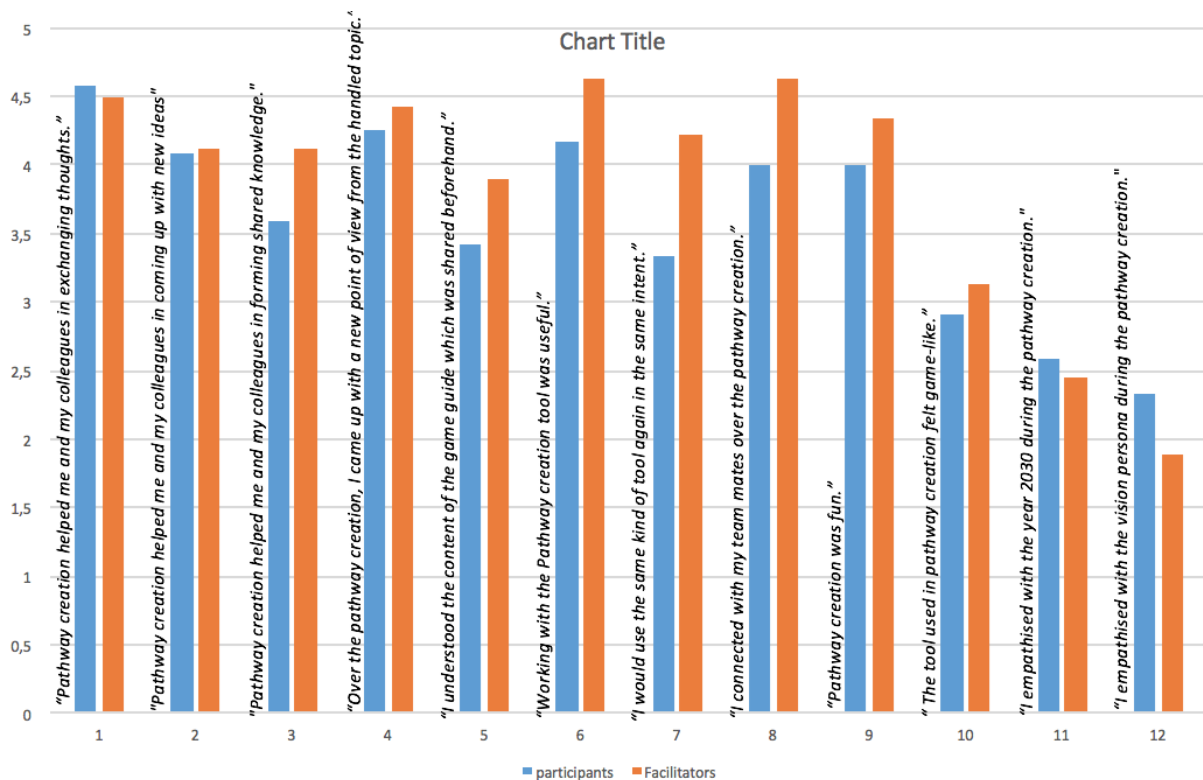


Figure 8. Participant and facilitator evaluation averages of twelve statements about the path creation tool.

The relatively low scores given to statements 11 and 12 regarding envisioning 2030 and empathizing with the vision personas reveal that our attempts at generating a more experiential near future were either not either experiential enough or not seen as relevant given that the focus of the arena was on system-wide actions and the whole mid-range time span. Also our primary aim with the personas had also been to convey cognitive information about the goal state in 2030 rather than generating empathy.

Responses to statement 10, about the pathway creation tool being experienced as a game by and large matched the design team's intention: to borrow elements from game design but retain the path creation tool as a collaborative envisioning tool that would not become too playful or seen as a simulation game. This could have curbed the openness of deliberation among participants. Finally, the averages between 3.5–3.7 for statement 5 (on the provided manuals for the process) draws attention to the time limits that some the busy, highly positioned participants had when familiarizing themselves with the tasks beforehand – the design team's pictorial guide received positive feedback from many participants but it could not be internalized in just two minutes, as some clearly expected to do.

In the final feedback discussion and in open-ended responses, the participants emphasized that the real innovation in the pathway creation tool was that it had forced them to create concrete pathways and be able to notice how difficult it is to carry out such a process and prioritize single, truly relevant steps. The participants were happy about the facilitation of the process and regarded the pathway creation as good facilitation technique which did not feel like 'traditional workshopping, but focused work' (as one participant phrased it). The facilitators' insistence on coming up with documentation instead of talk and on concrete solutions was seen as valuable, as well as the emphasis on identifying causal connections and system interrelations. Several participants also suggested that the process could be applied for several other purposes if it could be somewhat tailored.

*[The path creation tool] illustrated the complexity of issues outstandingly, as well as the need for a concrete operation path along with a long-term vision in order to take things in the right direction. The pathway creation tool could/should also be utilized in policy and strategy planning. (participant feedback)*

Also, some critical considerations were raised. One participant felt the pathway building process took longer than expected, another felt that the goals, steps, means, immediate changes and measures resulted in too much complexity and a somewhat disorganized way of working. A final critical remark concerned the division work: could the participants not just give short, insightful presentations to each other and then just use free conversation among each other? This implies that the pathways would then be constructed by the organizers for the participants' commentary.

The organizing team members appraisal of the tool was mostly positive, and the tool was voiced to be logical, visually ambitious and pleasant. One facilitator thought that possibly the biggest end result for pathway creation was the new way of working. The qualities of the tool were seen as inseparable from the overall process though:

*[Visualizing the pathways] worked well, although it was important that the structure supported iterations since some structuring had to be made. Often success was thanks to the good facilitators and well-selected participants. (an organizational team member)*

This also pointed to difficulties in the facilitation process in two groups in which the whole structure of the pathway changed several times, causing plenty of work for the facilitator and note taker. It was also sometimes difficult to distinguish which actions were supposed to be categorized as *pathway steps* and which as actions supporting those steps. Finally, some facilitators were concerned that maybe the pathway creation did not support raising 'extra innovations'.

Overall, the feedback indicates that the pathway creation tool was appraised positively and that it helped the pathway concretization process, the sharing of expertise and the generation of new insights. The limited time frame for creating complex pathways led both the participants and organizers to recognise that some steps and ideas required more refinement, and whilst some refinement could be made for the final report (through rounds of commentary), the participants continued to express willingness to go deeper into the topics after the process. The high level of expertise among the participants and facilitators was a key aspect to successful work in a very fast-paced process, but, at the same time, these same qualities led to a scarcity of time for the process for some participants.

## **6 Conclusions**

In many countries energy policy is undergoing a thoroughgoing shift from ensuring supply capacity to managing system transitions. The dominant energy system, based on fossil fuels, relies on large centralized production units that respond to fluctuating demand. With the increase in intermittent renewable wind and solar energy, energy efficiency measures, demand response and storage solutions, and active prosumer roles the energy system is moving towards far higher distribution and interactivity. The real question is of how each country and region can move from the current system to the future one – not only is the transition complex to manage but the policy and business cultures in the energy sector are not geared towards transitional thinking.

To catalyse the needed changes, methods of transition governance provide an important alternative. In the course of the current paper we have discussed how codesign for sustainability transitions can help improve the means used in transitions governance. The redesign of the path creation toolsets and procedures rendered the transition arena work better suited for mid-range planning, they aided more effective participant interactions and deliberation, and they elaborated one way to adjust transition governance to the specificities of country contexts (contexts which feature important variation).



The design challenges for the pathway creation system outlined in Section 2 were mostly well addressed by our design when judged by the participant and facilitator feedback. The notation, elements and procedures we developed were sufficient for fast-paced multidisciplinary teamwork in the arena. Embedding these into templates and materials that could be easily and flexibly altered appears to have been a good solution too. Regarding shapes, hexagons are used in countless board games and their affordances for combinations (as well as potential future alterations) are thus well known. The dimensioning of elements and the metallic board also worked well and produced the kind of conditions for small group work that we envisioned. Opting to use off-the-shelf materials that could be easily altered, shared and ordered (basically 2 mm thick refrigerator magnet material, plain iron sheets with a taped pattern on top, the WordPress based website, forms and digital easily adjustable templates made with InDesign, Illustrator and MS-Word) worked well by and large. The easy production of elements currently allows ongoing tailoring of the arena elements for different contexts. To aid documentation and commentary, the physical tools were paired with digital templates to which the form and content could be relatively easily transferred, and these digital elements worked sufficiently for documentation and commentary. Regarding the procedures and facilitation, the creation of a clear procedure for the pathway creation process allowed for creating participant and facilitator guides, which proved useful the arena process. At the same time, the pathway creation system does not work as a stand-alone kit (at least, not yet) and requires facilitator training and domain-specific background info package creation, and it is greatly helped if facilitators have domain knowledge that allows them to take the initiative in shaping the unfolding path on the pathway canvas. Video tutorials could potentially be made to lessen the training needs in the future. Overall, both participants and organizing team members found the path creation system to improve interaction, the quality of discussions and in particular to anchor the discussion in concrete changes.

This work has implications for both design for transitions and design for governance more generally. Regarding designing for transitions, our work illustrates that there is plenty of important work designers and design researchers can pursue to enhance the main avenues of transition governance that have been set in motion by social scientists. Whilst transitions governance has a considerable multidisciplinary community and a history of analysing and fostering long-term systemic change (and it may well be illusory for design researchers to seek to ideate replacements for these models), the means used to facilitate these complex processes benefit from more targeted design.

Sustainability transitions affect wide constituencies of society and, as Voss et al. (2009) point out, this calls for wide civil society engagement, in other words, it calls for various forms of designing for governance. Codesign for sustainability transitions can take many forms, such as means created to aid multi-sectoral deliberation. At the same time our experience underscores that designing for governance is most effective as a multidisciplinary team effort in itself. The Helsinki transition arena redesign was pursued together with the SET-consortium policy and innovation scholars who have experience of years of interaction with relevant civil servants, politicians, business people, NGOs and so on. The in-depth domain understanding of policy cycles, remits, and persistent and current challenges in different governance institutions was vital for the success of our design. The domain knowledge was used to anticipate the issues that needed particular attention, tuning facilitators in the workshops, estimating participants' available time allotments, attainable goals and so on. Storming in with just the design team would have been far less likely to succeed.

Even though the pathway creation system worked well in the arena process, there are some clear avenues of further design and experimentation. Firstly, in the future the documentation procedures should be developed further to ease the transfer of content and form from the pathway boards to the digitalized environment. Illustrator and InDesign templates were found to be somewhat alien by anyone other than designers, and hence more commonly used programs could be explored for the purpose as most arena facilitators will not be designers. Ultimately, automatic digitalization would be preferred. Secondly, the transition arena process and tools should next be given to a city, regional or ministry "owner" who would take the main responsibility for the process and its documentation,

and the design researchers would only facilitate the process and be consulted about it. This may foster higher ownership of the results and reduce the workforce demands that were high in the current arena process. Third, the current pathway formation processes ended up varying facilitation techniques, ranging from a relatively structured one implicated by our facilitation instructions to loose, iterative and more discussion-heavy processes. Thus far it seems that the more structured facilitation is, the more effective it is and the less it sacrifices the quality of deliberation, but this should be tested in the future by running same pathways construction tasks with varying facilitation styles.

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